

1                   26.     (Twice Amended) A method of marketing telephone lines to  
2 customers, comprising:  
3             speed pre-qualifying each line for high-speed digital service or low-speed digital  
4 service by using one-ended electrical measurements;  
5             receiving requests for high speed digital data service from customers; and  
6             connecting at least a portion of the lines qualified for high-speed digital service to  
7 customers requesting high-speed digital service in response to receiving said requests.

1                   31.     (Twice Amended) A system for characterizing performance of customer  
2 lines for data transmission, comprising:  
3             a computer;  
4             a telephony switch coupled to a portion of the lines and adapted to connect the  
5 portion to a network, to perform one-ended electrical measurements on the portion, and to  
6 transmit the measurements to the computer;  
7             a measurement unit coupled to the switch and computer, the unit to make the  
8 measurements on a selected line at a lower frequency in response to receiving a command  
9 from the computer, the computer to predict data rates at a higher frequency for the  
10 selected line from the measurements, the computer being further adapted to:  
11             predict whether the selected line is disqualified for data transmission from the  
12 measurements thereon.

1                   53.     (Twice Amended) A method of detecting a bridged tap in a  
2 customer line, comprising:  
3             making one-ended electrical measurements on the customer line;  
4             determining [ome] one or more admittances as a function of frequency of  
5 the customer line from the measurements; and  
6             detecting that the customer line has a bridged tap in response to finding a  
7 signature of a bridged tap in the one or more admittances as a function of frequency.

1                   54.     (Amended) The method of claim 53, wherein [the signature is a  
2 frequency dependent property of one or more admittances] the method is used in  
3 qualifying a line for high speed data services and the one ended measurements are made  
4 at a frequency below the frequency of the high speed data services signals.

## CLAIMS

Nov. 1, 2001

1           1.     A method of predicting performance of a customer line for data  
2 transmission, comprises:  
3           measuring electrical properties of the customer line from a central location;  
4           identifying a line model for the customer line from the measurements;  
5           identifying a modem model for a modem selected for use with the line, the modem  
6 model providing performance data on the selected modem; and  
7           predicting performance data for the customer line when operated with the selected  
8 modem by combining the line and modem models.

1           2.     The method of claim 1, wherein the performance data comprises a data  
2 transmission rate.

1           3.     The method of claim 2, further comprising:  
2           predicting whether the customer line is disqualified for data transmission; and  
3           wherein the act of predicting performance data is in response to predicting that the  
4 line is not disqualified.

1           4.     The method of claim 1, wherein the act of measuring includes using the  
2 measurements to evaluate at least one admittance of the customer line at a plurality of  
3 frequencies.

1           5.     The method of claim 4, wherein the act of measuring includes finding at  
2 least two of  $Y_{tr}$ ,  $Y_{rg}$ , and  $Y_{tg}$  for the customer line.

1           6.     The method of claim 5, wherein the act of identifying a line model  
2 comprises:  
3           determining a frequency dependent attenuation from the admittances; and  
4           determining a normalized line length from the frequency dependent attenuation.

1           7.     The method of claim 4, wherein the act of identifying a line model  
2 comprises:

3           determining whether the customer line has a bridged tap.

1           8.       The method of claim 1, wherein the act of identifying a line model includes  
2       finding a frequency dependent line attenuation from the measurements.

1           9.       The method of claim 1,  
2           wherein the act of measuring includes driving the customer line with a signal at a  
3       plurality of frequencies; and  
4           the act of identifying a line model includes evaluating a property of the customer  
5       line for frequencies high with respect to the frequencies of the signal.

1           10.      The method of claim 1, wherein the act of measuring includes finding a  
2       noise level, a capacitance, and frequency dependent admittances for the customer line.

1           11.      The method of claim 2, wherein the modem model indexes predicted data  
2       rates by an averaged normalized line length and a noise level of the customer line.

1           12.      (Amended) A method of speed qualifying a customer line for data  
2       transmission, comprises:  
3           identifying a proxy line in a cable carrying the customer line;  
4           performing one-ended electrical measurements on the proxy line; and  
5           predicting a data rate for the customer line from the measurements.

1           13.      The method of claim 12, wherein the act of predicting a data rate further  
2       comprises:  
3           identifying a line model for the proxy line from the measurements;  
4           identifying a modem model for a modem to use with the customer line; and  
5           combining the modem model with the line model to obtain the data rate.

1           14.      The method of claim 13, wherein the act of identifying a line model includes  
2       finding at least two of  $Y_{tr}$ ,  $Y_{fg}$ , and  $Y_{tg}$  for the proxy line at a plurality of frequencies.

1           15.     The method of claim 14, further comprising one of inferring a mix of wire  
2     gauges and inferring the presence of a bridged tap from the found admittances.

1           16.     The method of claim 14, wherein the act of identifying a line model includes  
2     finding a frequency dependent line attenuation from the measurements.

1           17.     The method of claim 12,  
2             wherein the act of performing includes driving the proxy line with a signal having a  
3     plurality of frequencies; and  
4             the act of identifying a line model includes evaluating a property of the proxy line  
5     for frequencies high with respect to the frequencies of the signal.

1           18.     (Amended) The method of claim 13, wherein the modem model indexes  
2     predicted data rates by an averaged normalized line length and a noise level of the customer  
3     line.

1           19.     A method of marketing telephone lines to customers, comprising:  
2             speed pre-qualifying a plurality of the customer lines using one-ended electrical  
3     measurements performed from a central location; and  
4             setting billing rates of at least a portion of the lines at prices that depend on the speed  
5     qualification of the portion.

1           20.     The method of claim 19, wherein at least a portion of the acts of speed  
2     qualification include performing electrical measurements on a proxy line.

1           21.     The method of claim 19, further comprising:  
2             monitoring a portion of the customer lines after being placed in service by  
3             repeatedly performing one-ended electrical measurements on the portion; and  
4             determining new data rates of each line of the portion from the repeated  
5     measurements.

1           22.     The method of claim 19, wherein each act of speed pre-qualifying,  
2     comprises:

3 measuring electrical properties of one of the lines from the central location;  
4 identifying a line model for the one of the lines from the measured electrical  
5 properties;  
6 identifying a modem model for a modem to use with the one of the lines, the modem  
7 model to provide rate data on the selected modem; and  
8 predicting a data rate for the one of the lines when operated with the selected modem  
9 by combining the line and modem models.

1 23. The method of claim 22, the act of speed pre-qualifying the one of the lines  
2 further comprising:  
3 predicting whether the one of the lines is disqualified for data transmission; and  
4 wherein the act of predicting a data rate is in response to predicting that the one of  
5 the lines is not disqualified.

1 24. (Amended) A method of marketing telephone lines to customers,  
2 comprising:  
3 speed qualifying each customer line from one-ended electrical measurements, the  
4 speed qualifying classifying the lines for high speed digital service or low speed digital  
5 service; and  
6 offering the high-speed service to at least a portion of the customers in response to  
7 the portion having lines qualified to support high-speed digital service.

1 25. The method of claim 24, wherein each act of speed qualifying comprises:  
2 measuring electrical properties of one of the lines from the central location;  
3 identifying a line model for the one of the lines from the electrical properties;  
4 identifying a modem model for use with the one of the lines, the modem model  
5 providing data rates for the selected modem; and  
6 predicting a data rate for the one of the lines when operated with the selected modem  
7 by combining the line and modem models.

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1 26. (Twice Amended) A method of marketing telephone lines to customers,  
2 comprising:

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3 speed pre-qualifying each line for high-speed digital service or low-speed digital  
4 service by using one-ended electrical measurements;  
5 receiving requests for high speed digital data service from customers; and  
6 connecting at least a portion of the lines qualified for high-speed digital service to  
7 customers requesting high-speed digital service in response to receiving said requests.

1 27. The method of claim 26, wherein each act of speed pre-qualifying  
2 comprises:  
3 measuring electrical properties of one of the lines from the central location;  
4 identifying a line model for the one of the lines from the electrical properties;  
5 identifying a modem model for use with the one of the lines, the modem model  
6 providing transmission rate data on the selected modem; and  
7 predicting a data rate for the one of the lines when operated with the selected modem  
8 by combining the line and modem models.

1 28. The method of claim 27, wherein at least a portion of the measurements are  
2 performed on a proxy line.

1 30. (Amended) The system of claim 31, wherein the computer is adapted to:  
2 identify a line model for the selected line from the measurements thereon;  
3 identify a modem model for use with the selected line; and  
4 predict a data rate for the selected line when operated with the selected modem by  
5 combining the line and modem models.

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1 31. (Twice Amended) A system for characterizing performance of customer  
2 lines for data transmission, comprising:  
3 a computer;  
4 a telephony switch coupled to a portion of the lines and adapted to connect the  
5 portion to a network, to perform one-ended electrical measurements on the portion, and to  
6 transmit the measurements to the computer;  
7 a measurement unit coupled to the switch and computer, the unit to make the  
8 measurements on a selected line at a lower frequency in response to receiving a command

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9 from the computer, the computer to predict data rates at a higher frequency for the selected  
10 line from the measurements, the computer being further adapted to:

11 predict whether the selected line is disqualified for data transmission from the  
12 measurements thereon.

1 32. The system of claim 30, wherein the computer is adapted to:

2 determine a frequency dependent attenuation from the measurements; and

3 determine a normalized line length from the frequency dependent attenuation.

1 33. The system of claim 30, wherein the computer is adapted to command the  
2 measurement unit to order measurements on proxy lines and to predict data rates for a  
3 portion of the customer lines by using the measurements on the proxy lines  
4

1 34. A program storage device encoding an executable program for a method of  
2 speed qualifying telephone lines for data transmission, the method comprising:

3 measuring electrical properties of a customer line from a central location;

4 identifying a line model for the customer line from the measurements;

5 identifying a modem model for use with the line, the modem model providing data  
6 rates of the selected modem; and

7 predicting a data rate for the customer line when operated with the selected modem  
8 by combining the line and modem models.

1 35. The device of claim 34, the method further comprising:

2 predicting whether the customer line is disqualified for data transmission; and

3 wherein the act of predicting a data rate is performed in response to predicting that  
4 the line is not disqualified.

1 36. The device of claim 34, wherein the act of measuring includes finding at  
2 least one admittance of the customer line at a plurality of frequencies by using the  
3 measurements.

1 37. The device of claim 36, wherein the act of measuring includes finding at  
2 least two of  $Y_{tr}$ ,  $Y_{rg}$ , and  $Y_{tg}$  for the customer line.

1           38.     The device of claim 36, wherein the act of identifying a line model includes  
2 finding a frequency dependent line attenuation from the measurements.

1           39.     The device of claim 36, wherein the act of identifying a line model  
2 comprises:  
3           determining a frequency dependent attenuation from the admittances; and  
4           determining a normalized line length from the frequency dependent attenuation.

1           40.     The device of claim 34, wherein the modem model lists predicted data rates  
2 by averaged normalized line length and noise level of the customer line.

1           41.     The device of claim 40, the method further comprising:  
2           modifying the predicted data rate in response to a value of one or more quality  
3 parameters, the values characterizing the selected modem.

1           42.     The device of claim 41, wherein the parameters are selected from the group  
2 consisting of impulse noise compensation, noise floor, echo compensation and phase  
3 instability compensation.

1           43.     The device of claim 34, the method further comprising:  
2           identifying the customer line as a proxy line for a second telephone line; and  
3           predicting a data rate for the second line from the data rate predicted for the proxy  
4 line.

1           44.     A method of determining the attenuation of a customer's telephony line,  
2 comprising:  
3           performing a plurality of one-ended measurements of frequency dependent  
4 admittances of the customer's telephony line, the measurements being performed in a first  
5 frequency range;  
6           processing the measurements by a set of logical decision trees; and  
7           adjusting values of a frequency-dependent attenuation for an average telephony line  
8 to predict an attenuation of the customer's telephony line in a second frequency range, the  
9 act of adjusting being responsive to results from the logical decision trees.



1           45.     The method of claim 44, wherein the act of performing includes finding at  
2     least two of  $Y_{tr}$ ,  $Y_{rg}$ , and  $Y_{tg}$  for the customer's telephony line.

1           46.     A method of determining performance of a customer telephone line, the line  
2     having both a tip wire and a ring wire, comprising:  
3           driving one of the two wires with a first alternating voltage at one end and the other  
4     of the two wires with a second voltage at the same end and measuring voltages between  
5     each wire and ground while driving the two wires;  
6           driving the other of the two wires with a third alternating voltage at the same end  
7     and the one of the two wires with a fourth voltage at the same end and measuring voltages  
8     between each wire and ground while driving the two wires;  
9           driving both the tip and the ring wires with a fifth alternating voltage from the  
10    same end and measuring voltages at the tip and ring wires while driving both wires; and  
11    determining admittance  $Y_{tg}$  at a plurality of frequencies from the measured voltages.

1           47.     The method of claim 46, further comprising:  
2           determining an apparent length of the customer line from values of said admittance  
3     at a plurality of frequencies.

1           48.     The method of claim 46, further comprising:  
2           determining whether the customer line has a bridged tap from values of said  
3     admittance at a plurality of frequencies.

1           49.     The method of claim 46, further comprising:  
2           determining the remaining admittances  $Y_{rg}$  and the admittance  $Y_{rt}$  at a plurality of  
3     frequencies from the measured voltages.

1           50.     The method of claim 49, further comprising:  
2           determining a frequency-dependent attenuation of the line from the measured  
3     admittances.

1           51.     The method of claim 50, further comprising:  
2           predicting a data rate for the line from the attenuation; and

3 adjusting the predicted data rate in response to a rating of a gauge mix of the line.

1 52. The method of claim 50, further comprising:  
2 determining whether the customer line has a bridged tap from values of said  
3 admittances at a plurality of frequencies;  
4 predicting a data rate for the line from the attenuation; and  
5 adjusting the predicted data rate in response to determining that the customer line  
6 has a bridged tap.

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1 53. (Twice Amended) A method of detecting a bridged tap in a customer line,  
2 comprising:  
3 making one-ended electrical measurements on the customer line;  
4 determining one or more admittances as a function of frequency of the customer line  
5 from the measurements; and  
6 detecting that the customer line has a bridged tap in response to finding a signature  
7 of a bridged tap in the one or more admittances as a function of frequency.

1 54. (Amended) The method of claim 53, wherein the method is used in  
2 qualifying a line for high speed data services and the one ended measurements are made at a  
3 frequency below the frequency of the high speed data services signals.

1 55. The method of claim 53, wherein the one or more admittances is an  
2 admittance between a wire of the customer line and ground.

1 56. The method of claim 53, wherein the act of making one-ended  
2 measurements performs the measurements through a voice test access of a telephony  
3 switch.

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57. (Amended) The method of claim 53, further comprising:  
2 determining whether a ratio of imaginary and real parts of a frequency derivative of  
3 one of the one or more admittances has a peak; and  
4 wherein the determining is based on finding an above threshold peak in the ratio.  
1